MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2017/2018

TCS3511 THEORY OF COMPUTING/
TIC2151 THEORY OF COMPUTATION/

(All sections / Groups)

24th October 2017
2:30 pm -4:30 pm
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 4 pages only excluding the cover page.
2. Attempt All questions. The distribution of the marks for each question is given.
2. Please write your answers in the answer booklet provided. Please write the question number of each answer clearly.

QUESTION (1)

NOTE: Attempt any THREE out of FOUR Parts (A), (B), (C) and (D).

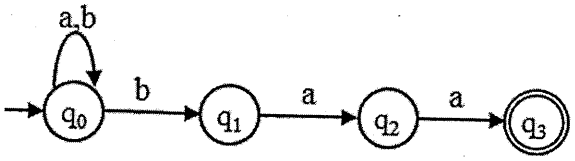
(A) Draw state diagrams for DFAs accepting each of the following languages:

$L_1 = \{w \in \{0, 1\}^* \mid w \text{ is the set of strings that start with } 010\}$ [2.5 marks]

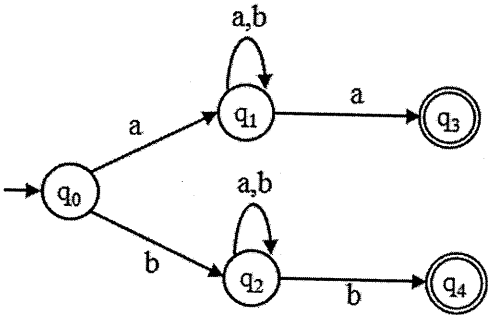
$L_2 = \{w \in \{a, b\}^* \mid w \text{ has neither } aa \text{ nor } bb \text{ as a substring}\}$. [2.5 marks]

(B) Draw the state diagram for DFAs accepting the same languages as the following NFAs. [5 marks]

1.

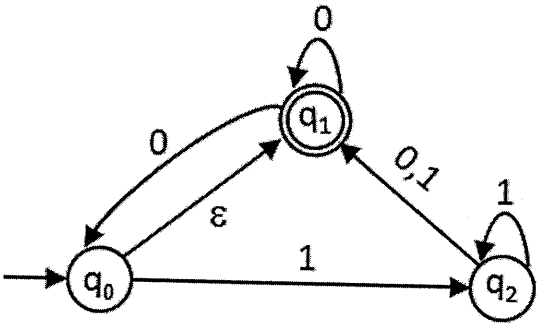


2.



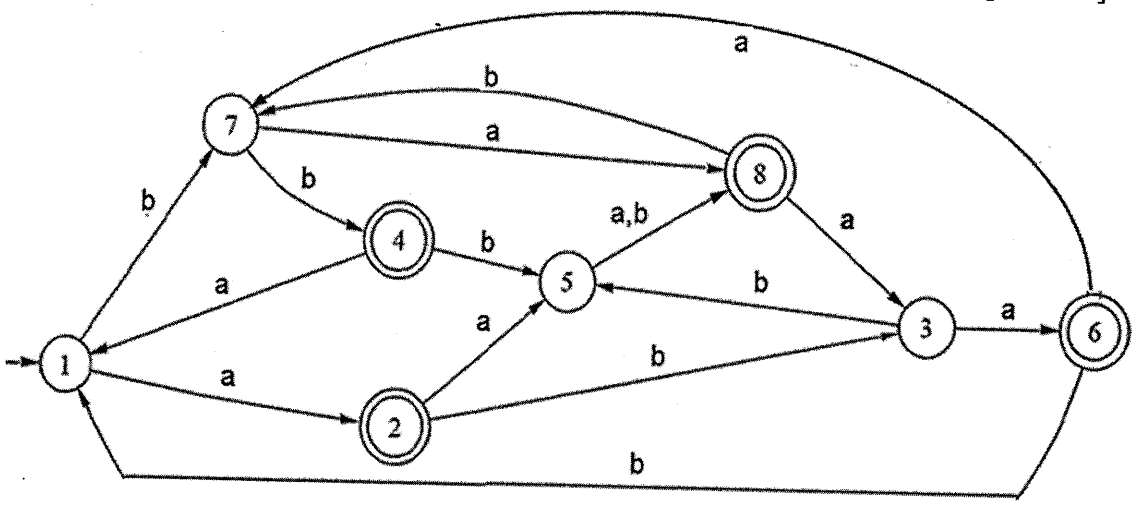
(C)

1. The NFAs are defined in the same way as DFAs but with two main exceptions, what are these exceptions? (explain briefly) [2 marks]
2. Convert the following NFA into an equivalent DFA. Show your steps. [3 marks]



(D)

Minimize the following DFA. Show your steps. [5 marks]



QUESTION (2)

(A)

1. Determine the language corresponding to each of the following regular expressions:

   i. $0\,(0+1)^*\,0+1\,(0+1)^*\,1+0+1$ [1 mark]

   ii. $(0+1)^+\,1+(0+1)^*10$ [1 mark]

2. Find a regular expression corresponding to each of the following languages. [3 mark]

   i. $L = \{w \in \{0, 1\}^* \mid |w| = 4\}$

   ii. $L = \{w \in \{a, b\}^* \mid w = a^{2n} b^{2m}\ , n,m \geq 1\ \}$

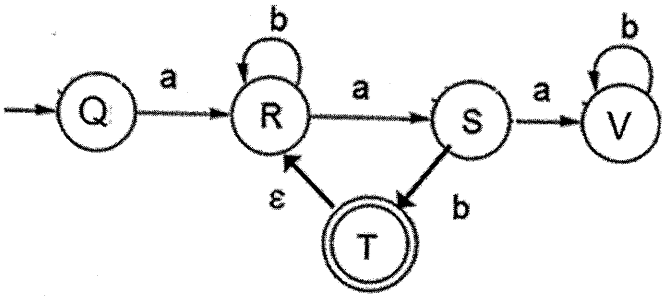
   iii. $L = \{\ w \in \{0, 1\}^* \mid$ String w contains one occurrence of the string 00$\}$.

(B) Convert the following regular expression into an NFA. Follow the construction rules closely and do not just give a simpler NFA even though it is possible. [5 marks]

$$(0+1)^*0\,(1)^*$$

(C)

1. What is the regular grammar corresponding to the NFA given below? [3 marks]



2. Give the regular grammars corresponding to each of the following languages over the alphabet {a, b}.

   $L_1 = a^*b^+a$ [1 mark]

   $L_2 = ab(a+b)^* + (a+b)^*\,bb$ [1 mark]

QUESTION (3)

(A) Construct a PDA over the alphabet {a, b, c} for each of the following languages:

$L_1 = \{a^n b^{n+m} c^m \mid n,m \geq 1\}$ [2.5 marks]

$L_2 = \{ wcw^R \mid w \in \{a, b\}^+\}$. [2.5 marks]

(B) Give the context free grammars corresponding to each of the following languages over the alphabet {a, b}:

i. $L_1 = \{ a^n b^m \mid m, n \geq 1\}$ [1 marks]

ii. $L_2 = \{a^n b^m \mid m > n, m, n \geq 1\}$ [1 marks]

(C) The following CFG grammar is in Chomsky normal form. Use the Cocke-Younger-Kasami (CYK) algorithm to determine whether the word *aabbabbb* can be derived from this grammar or not. Show your proof. [3 marks]

B => BB | XA | XY

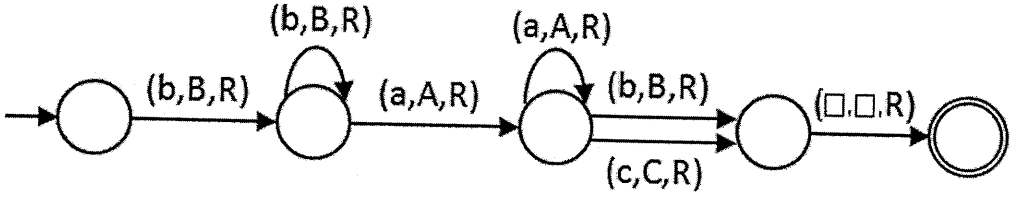
A => BY

X => a

Y => b

QUESTION (4)

(A) What language does the following Turing machine accept? Give the language in regular expression form. [2 marks]



(B) Construct a Turing Machine for the language $L = \{10^n1^n \mid n \geq 0\}$.. [5 marks]

(C) Briefly define both *Turing-decidable* and *Turing-recognizable* languages. [3 marks]

End of page.